Toward Refining Risk Assessment: Predictive Blood Lead Modeling and Improved Protection of Children's Health

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Key Words: children, lead, soil, dust, Superfund

More than a century of mining and smelting at Bunker Hill contaminated soil and interior dust with lead and other metals. Following closure of the smelter in 1981, lead in soil and dust were identified as primary exposure pathways for children living in Silver Valley, Idaho.

Soil and dust have been sampled annually as contaminated soil was replaced with clean soil at schools, parks, businesses, and approximately 2,200 residences. Annual voluntary blood lead screening has recruited over 50% of exposed children every year since 1988. Blood lead levels have decreased as soil and dust lead levels have declined as the soil cleanup progressed. Bioavailability was estimated by comparing lead uptake from over 5,000 blood lead measurements paired with estimates of lead intake from thousands of soil and dust measurements. Lead intakes were estimated using a range of assumptions of the relative importance of lead levels in 1) house dust, 2) residential soil from a child's own yard, 3) soil from neighboring yards, and 4) the mean concentration from all yards in a town. The impact of various exposure assumptions on the estimated intake was minimal because of intercorrelations among these four sources of exposure.

The Region 10 EPA office partnered with the Panhandle Health District, the State of Idaho Department of Environmental Quality, the EPA Office of Research and Development, and the Idaho Department of Health and Welfare in both conducting the work and applying the results.

Since 1989, when residential soil cleanup began, children's blood lead concentrations in Silver Valley, Idaho have been significantly decreasing. Blood lead concentrations are now close to the U.S. national average. But annual variation has been observed. This work suggests that the source of variation may be an increased uptake of lead from contaminated dust. Greater bioavailability of lead in dust may be caused by smaller particles in dust relative to soil which may account for an increase in bioavailability (due to greater surface area) and ingestion rate (smaller particles are more likely to cling to hands and fingers). Prior to the results of this work, it was difficult to distinguish the roles of the four interrelated sources of children's exposure. This work provides support for continued soil remediation, for continued blood lead testing, and for public health outreach. Risk managers can now target and prioritize actions to more effectively impact children's blood lead status.